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DEPARTMENT OF AGRICULTURE,

SYDNEY, NEW SOUTH WALES.

32

Miscellaneous Publication, No. 519.

THE CALIFORNIAN WHEAT INDUSTRY:

111259

BY

Nathan Augustus
N. A. COBB.

PUBLISHED BY THE AUTHORITY OF THE GOVERNMENT OF THE STATE OF NEW SOUTH WALES.

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1901.

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The Californian Wheat Industry.

[*Illustrations from Photographs recently taken by the Author.*]

N. A. COBB.

Author's routes.

I.

MOTIVE.

CALIFORNIA produces 25,000,000 to 30,000,000 bushels of wheat annually. This wheat is of the same class as that grown in Australia; in fact, much of it is derived from seed of varieties that were first produced in Australia, and are still largely grown here. The climatic conditions of much of the Californian wheat area are remarkably like those prevailing in many parts of Australia, being characterised by a hot, dry summer, following on more or less rainy winter months.

Most of this Californian wheat is exported either to Europe or the East, or to Central and South America; occasionally it has been sent to Australia. These enterprising people are sending their wheat not only to China and Japan, but actually to Europe by way of the Pacific and the Suez Canal; in other words, are growing wheat of the Australian class and sending it in steamers, six thousand miles further, to the same market. The fact that wheat of our own class, grown under climatic conditions similar to ours, is made the basis of a large export trade cannot fail to be of interest to our wheat-growers and merchants, and any lessons to be learned from a study of the particulars of such an industry are lessons we should master at the earliest opportunity. This thought gave zest to much of my recent travel in California and other Pacific Coast States of North America.

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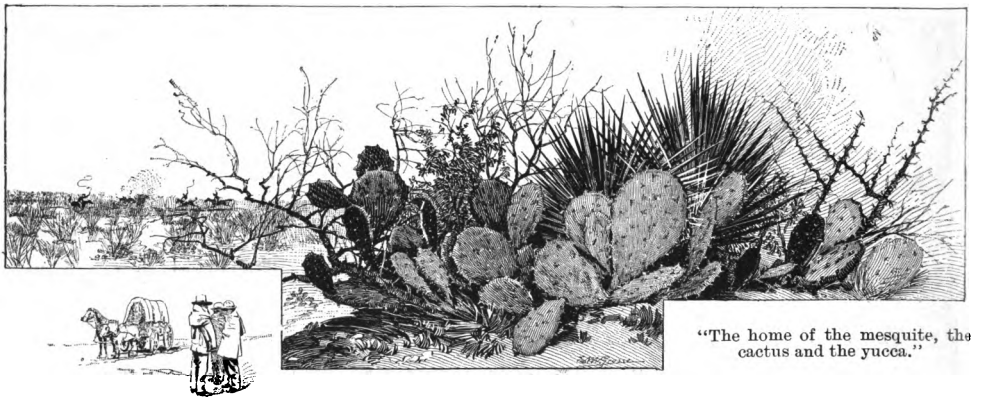
II.

SAN DIEGO TO LOS ANGELES.

SAN DIEGO, in Southern California, is the natural starting-point of one proposing to traverse the Pacific Coast of the United States from south to north. Beginning there and casting a last longing look southward to the home of the mesquite, the cactus and the yucca, and travelling northward through California, Oregon, and Washington, one may, at the proper season—namely, in the months of June and July—study to good advantage the wheat industry of the entire region, an industry having, as already stated, great interest to Australians because of the climatic conditions under which it is carried on. The rainy winters and the hot, dry summers of much of California are so nearly like the corresponding seasons in many parts of this State that the farmers of each of these regions may learn much from those of the other.



"The home of the mesquite, the cactus and the yucca."

During three seasons I had opportunities to observe and study Californian methods of dealing with wheat; and the following pages contain some of the results of my observations, more particularly for the summer of 1899, when, partly on my own itinerary, and partly as the guest of the people of San Francisco and of the Agricultural Colleges and Experiment Stations of the United States, I visited all the important agricultural industries of the Pacific Coast, travelling, with this object, several thousand miles.

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For the sake of simplicity, it will be assumed that everything was seen in one trip, beginning at the south on the Mexican border, and

"Beginning at the south, on the Mexican border."

ending at the north at Seattle, Washington, instead of, as was actually the case, during half-a-dozen trips spread over three seasons. The present observations, moreover, will be confined principally to wheat. My observations on fruit-growing, fruit-packing, fruit-shipping, fruit-storage, fruit-drying, fruit-canning, artesian irrigation, mountain irrigation, olive oil making, wine-making, raisin-growing drying and seeding, fruit machinery, weather signals, celery-growing, orchard machinery, etc., etc., I must leave for other occasions.

For centuries the climate of certain parts of Southern California has been noted for its mild equability and dry healthfulness. In consequence it has become a resort for thousands of people in search of better health and a prospect of longer life. These people have brought with them wealth, culture, and brains. Their wealth they have devoted to founding the beautiful homes their culture has made so wonderfully attractive, and to exploiting the natural resources of the country, which their brains have enabled them to discover, and above all, to advertise. The prosperity of the region depends on tourist wealth, and irrigation as applied to fruit-culture.

In this part of California, wheat-growing cuts a small figure. The rainfall is too uncertain and meagre for even the earliest of drought-resisting varieties. Large areas are utter desert, and irrigation waters are at present too valuable for fruit-trees to be wasted on wheat. It is only here and there that one sees smallish areas of wheat grown under special conditions, the variety Sonora prevailing, so far as I could learn. There was so little wheat grown here that I did not give this crop the careful attention I devoted to it in the San Joachin and Sacramento Valleys.

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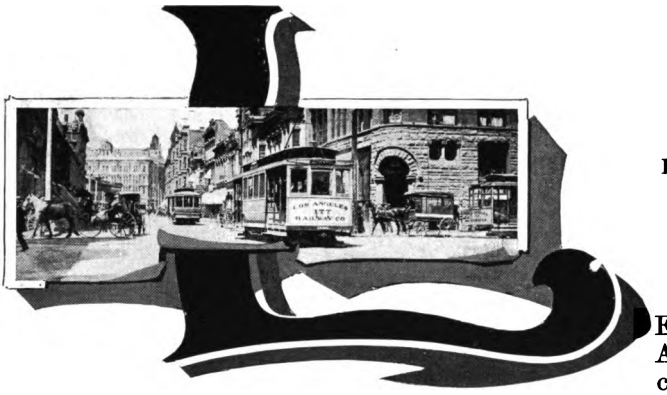

III.

LOS ANGELES TO BAKERSFIELD.

LEAVING Los Angeles, the chief city of Southern California, the north bound mid-day train traverses the great fruit district for twenty-five miles or so and then enters the Sierra Madré mountains, and after a couple of hours of climbing descends into the Mojava Desert, here some fifty miles wide and as flat as a floor. Sand, yucca, and cactus present a hot monotony until toward evening, when we begin to climb up toward Tehachapi Pass.

Impressions taken on the spot and preserved on photographic plates, or in letters, will give a more vivid conception of this land as I saw it, than any amount of cold and patient recollection. I have, therefore, no hesitation in presenting here certain illustrations so procured, nor in inserting, in quotations, certain extracts from my correspondence. Of course it will be understood that after the work and worry of the day, and in a comfortable room, the chance to chat in a letter to some life-long intimate, leads to less restrained methods and a more careless style. If the reader will kindly allow for these he may glean from these letters and illustrations some clearer conception of my route and impressions.

"Bakersfield, California,
"10 a.m., Sunday, June 18, 1899.

"Dear A———,

"Bakersfield, as you will find on consulting the map, is half-way between San Diego and San Francisco, and is near the head waters of the San Joachin River. As its name indicates, its climate is so hot that no oven is needed for *baking*, any open place or *field* answering the purpose. It was barely 106 degrees in the shade yesterday, so we feel rather slack-baked; but the heat will soon reach the regulation pitch, when it is hoped there will be no further cause for complaint. The people say, 'Well, you see, this is the San Joachin Valley.' That is their explanation.

"And yet there are hotter places—the Mojava Desert, for instance. When we arrived at Mojava depôt yesterday, the depôt people (there are no other people at Mojava) were shaking their heads and saying the temperature was 113 degrees in the shade. It may be; the fact is, I found the desert so interesting that I forgot the heat. However, most people remembered the heat and forgot the desert—except one poor couple, who could remember nothing but their young daughter who had just died, and whose remains they were bringing to Bakersfield from Los Angeles, where she had been

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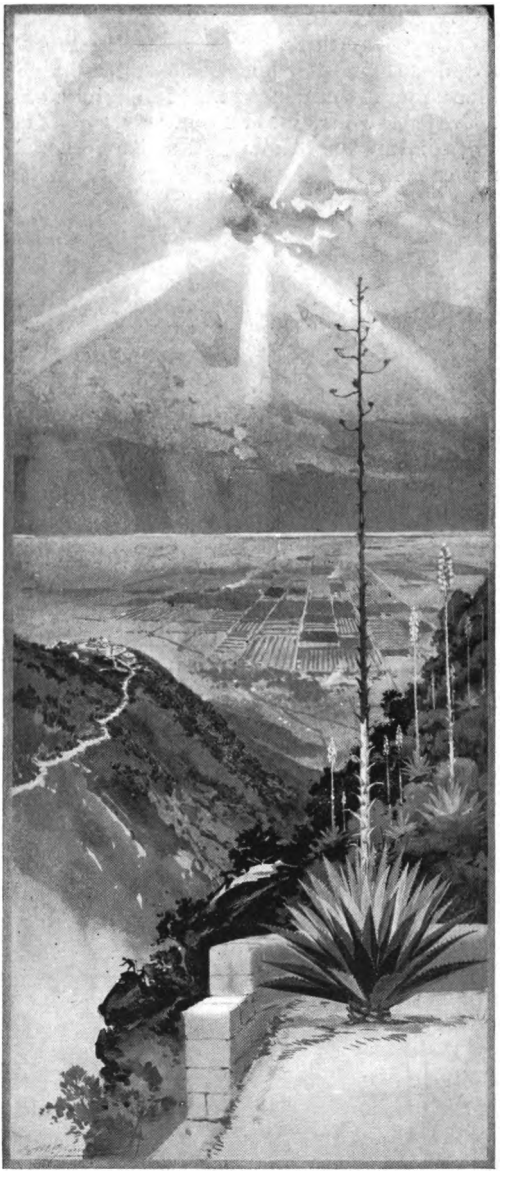
attending school. Life did not seem worth much to them, and the desert was not calculated to restore their spirits, though it did seem so interesting to one of their fellow passengers.

"The Southern Pacific Railway, leading from Los Angeles to San Francisco, passes west of the Sierra Madré Mountains and climbs up into a corner of the Mojava Desert,—the same scorching kind of desert I think I wrote you of crossing in Arizona on entering Southern California. It is the land back to which the dead-and-gone-to-hell United States Regular is alleged to have sent his ghost in search of blankets, — the climate of Hades being a little cool in comparison with that to which he had been accustomed.

"Climbing up into the desert, the road took us through dry ravines of the foot hills of the northern Sierra Madré. These ravines are the Titanic flues that, heated by the summer sun, suck the sea-air inland, and so temper the coastal climate of the region. A few orchards of apricots, a bee-farm or two with scores of whitewashed hives, and a series of railway depôts solely for the use of the trains: these were the only signs of civilisation. Otherwise the mountain flowers bloomed in fastnesses as wild as though the white man had not yet arrived. Spanish Bayonets sent up great bouquets of creamy white flowers, as tall as soldiers and as well 'dressed'—ornaments appropriate to the sides of great hills. About their feet, scattered shrubs and herbs bore flowers of yellow, blue, white, purple, and red —a pasture-land for bees.



"Spanish Bayonets sent up great bouquets of creamy white flowers, as tall as soldiers, and as well 'dressed'—ornaments appropriate to the sides of great hills."

"Suddenly the train reaches a down grade, and we speed along for a few minutes, and then in mid-afternoon shoot out into the hot, dry Mojava, flat as

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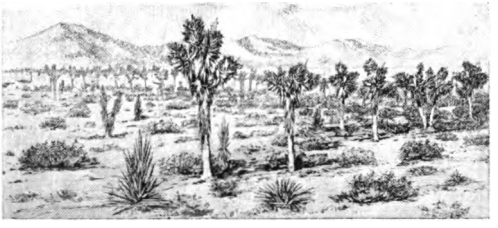
a floor, and bearing only a scattered growth of cactus, sage, and yucca—desolate but beautiful. The mountains towards Barstow, where I last left the desert on the Santa Fe route, though assuredly fifty miles away, appeared no more than ten. Mountains of such entrancing hues are to be seen under no other conditions, it seems. There must be fifty to one hundred miles of flat, dry country, with stupendous mountains at the back: then are born such blues, purples, and unheard of delicacies of colour, as lead some into superlatives and others into silence.

"I hardly know how to describe to you fifty miles of this desert; be sure my camera will do better than I. This extraordinary-looking camera is a source of conversation and entertainment wherever it goes; its owner sinks into the position of a mere accessory. A man asked me the other day to play a tune on it—he thought it was some kind of musical instrument! It has been taken for a surveyor's instrument, and a telephone, and heaven only knows what else by people who have kept their thoughts to themselves! I work calmly on, the cynosure (isn't it?) of all eyes. Yes, calmly! At least so I shall maintain until developments disclose how many times I have put two pictures on one plate, and how many times I have fired with the cap on.



"I hardly know how to describe to you fifty miles of this desert; be sure my camera will do better than I."

"Thus I sat looking, observing, and shooting, yesterday, from 2 p.m. to 5 p.m. in the train on the Mojava. I quartered a plate and secured (so I shall allege) four characteristic views, each showing the desert yucca, which is in some places so abundant as to give rise to such names as 'Palmdale' on the desert depôts. It is some compensation when you live in a desert depôt to have it named 'Palmdale' in black letters a foot high.

"This yucca* does bear some resemblance to a small palm. At first, as a seedling, it appears like a green porcupine in the sand—a diminutive Spanish Bayonets. Instead, however, of remaining terrestrial, it slowly mounts upward on a pillar clothed with reflexed leaves, which finally branches like a stag's horn, each branch terminating in a growth resembling the aforesaid green porcupine. True to the yucca tribe, it bears its flowers in panicles. These yuccas seldom reach twenty feet in height, and are the only plants on the desert that exceed a foot or two in altitude. Why these plants should have a human appearance is hard to say, but they do. In their prime they are erect, and proud looking, but they die pathetically—droop and hang limp. I saw one that had been uprooted, and the roots were like scores of wires passing, I know not how deep, into the sand.

"Imagine the sage-brush alkaline desert we know so well, to be diversified by these yuccas, and by cacti of a branching digitate kind; with no birds except a solitary buzzard at some depôt; and no animal life except one squirrel and a herd of cattle near the single artesian well; then you have the Mojava as I saw it yesterday.

* *Yucca brevifolia.*

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"Other people saw it differently; some failed to see it at all, though they could not fail to feel it. There was one woman who saw nothing but one man; he was her husband, and was employed at one of the depôts, where she was going to join him, and where evidently there was no place for her, or, perhaps, for her little girl to go to school. She was looking forward out of the window before she was within twenty miles of her destination, and if we had run through a drove of grizzly bears on that desert I dare say she would not have known it.

"Of course the beautiful part of a desert is where you go out of it, and so it was last night. As the sun began to sink in the west, the train steamed out of Mojava and began to climb into the mountain pass that leads over into the San Joachin Valley. The rails ahead gleam in the oblique sunlight like lines of polished silver, leading in great sweeping curves up, up, always up, into a narrow, green, alpine valley. We see the last of the yuccas, the last of the sage, the last of the sand, and we reach the summit, whence we slide down without steam through eighteen tunnels and round innumerable curves into the valley to the north, happy that there is an engine in front to keep us from sliding too fast. Some people slid down this grade once without an engine. They succeeded in sliding about a mile; where those people went to then, no one knows, for the train jumped the track, smashed, caught fire, and roasted them.

"If you would realise the grim side of railway travel, ride, as I did last night, with an old engineer, who, as he put it, 'knows every tie on the mountains.' To him the entire line is a series of places 'where things have happened.'

"'You see that ravine there? That's where those two sleepers jumped the track, caught fire, and burned six or seven people to death, in '82. How did it happen? Well, you see, they were disconnecting the helper engine, which had been put on to pull them up the mountain. Both engines were disconnected, and all the train men had got off. No one saw the train start to run away until it was too late, and off she went down towards Bakersfield. The two sleepers were behind—that is, had been up front—and they formed the snapper end of the runaway, and they were derailed and smashed and burned. There happened to be an old railroad man aboard the regular carriages, and the unusual motion woke him out of a doze, and made him suspect that something was wrong. He rushed out to find the conductor, went up front, found the train going backward without any engine, applied the brake, and succeeded in stopping the train. We are coming right now to the tunnel where he pulled her up.'

"'Right along here is where I had a ticklish job once. The grade all along here is 116 feet to the mile. It was in the days before air-brakes. I was taking down a couple of cars, when the brake-chain broke, and the only brake I had left was the brake on the tender. I'd let her get to going just as fast as I dared, and then put on the tender brake and reverse her. I had to keep on that way till I got down where I could shunt. Maybe you think I wasn't on pins and needles for a couple of hours!'

"'You see that big chunk gone out of that cutting? That whole lot slid down on to the track one day in front of my train. We just escaped a smash and being rolled off into the canõn. When I brought her to a stop she wasn't eighteen inches from the rocks.'

"'Right along here is where that front engine went off the track; nobody knows why. She turned right square round. Nobody hurt but the fireman; he was caught between his tender and the back engine, and killed.'

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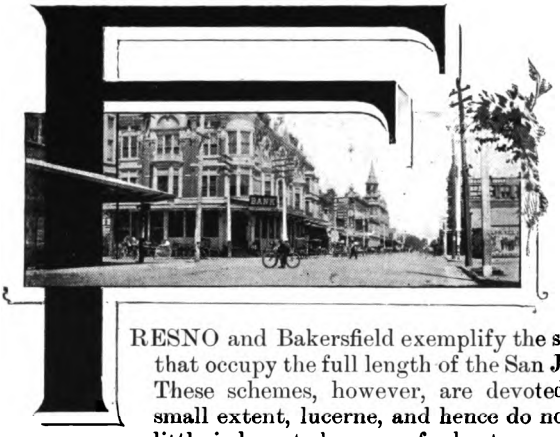
"So the old engineer entertained me, telling me of the peculiarities of the line, of the particulars of the loop, of where the antelope congregate for water, and of the shiftlessness of mountain squatters.

"This is the centre of an agricultural region I am now about to examine. It is quite a little town, with Californian characteristics. It is Sunday, but most of the stores are open and doing business. Opposite is 'J. Winterhill, Men's Outfitter, The Poor Man's Friend, Originator of Low Prices.' I went across and saluted him.

"I said, 'How are you, Originator? How are you getting on, old man? I've often wanted to meet you, and pay my respects. You don't look as aged as I expected, but never mind. How goes it? I tell you what it is, Originator, there are few men who deserve more honour than you do!'

"I did this just to see what he would say, and so I did it in imagination. He (in imagination) looked at me as if he thought me 'a little m——, you know,' and after the necessary explanations, sold me a hat at 25 per cent. above the ruling price." * * * * * * *



IV.

SAN JOACHIN VALLEY.

RESNO and Bakersfield exemplify the series of great irrigation schemes that occupy the full length of the San Joachin and Sacramento Valleys. These schemes, however, are devoted to producing fruit and, to a small extent, lucerne, and hence do not interest us at present. Very little is here to be seen of wheat grown by irrigation. The south end of the valley has too low a winter rainfall to encourage wheat-growing.

View of the ear and grain of "Sonora" wheat, or, as it is called in Australia, "Velvet Pearl." The ear is shown about one-half size; the grains are shown full size. The ear is cut in two near the middle, and the upper half turned quarter way round, so as to give both profiles in the one view. The lower grain is seen from the back, the central grain from the side,—the top grain being shown in section. No attempt is made to show the velvety nature of the chaff. The drawings were made from carefully selected average specimens.

Soon after leaving Bakersfield, on the journey northward, one notices the rapid increase in the amount of wheat. From Tipton to Tulare, and so on to Goshen, are thousands upon thousands of acres of nothing but Sonora wheat. The flat, floor-like valley, bordered on the east by the snow-capped Sierra Nevada Mountains, plainly to be seen, and on the west by the lower and snowless Coast Range, seems almost covered in some parts from edge to edge with this brilliant, red-headed and yellow-strawed variety. Very few places in the world can show such an overwhelming predominance of a single cultivated variety.

The prevalence of the Sonora wheat in the upper part of the San Joachin is explained by the earliness of this variety of wheat, and its suitability to a

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dry climate. It comes in early and yields grain, even in those seasons when the spring rains cease early, and when, in consequence, the hot, dry summer begins early. In spite of the fact that it sells for a lower price than other varieties, and in spite of the fact that the flour yielded by its grain is not of a popular colour, it continues, not only to be grown, but to constitute the bulk of the grain raised in this dry region. Long afterward, I again saw decisive evidence of the great prevalence of this variety in California. It was at the Paris Exposition, where I noticed that more than half the wheat exhibited by the San Francisco Produce Exchange was of the Sonora variety, the balance being mostly Golden Gate Club, of which I shall speak again later on.

View of the ear and grain of "Allora Spring" wheat. The ear is shown about one-half size; the grains are shown full size. The ear is cut in two near the middle, and the upper half turned quarter-way round, so as to show both profiles in one view. The lower grain is seen from the back, the central grain from the side, while the upper grain is shown in cross-section. The drawings were made from carefully selected average specimens.

Sonora is the wheat known in this State under the name of Velvet Pearl, a name which I am convinced has no precedence over that of Sonora, and which I am almost certain would now be abandoned by the Australian Nomenclature Committee in favour of the name Sonora. I made numerous careful examinations and comparisons with specimens of our Velvet Pearl, which I had with me for the purpose, and of the identity of the two varieties I have not the slightest doubt. I noticed, however, that our Allora Spring was sometimes grown in California under the name of Sonora. Some of the characteristics of Sonora and Allora Spring are quite similar.

Near Fresno the predominance of Sonora begins to wane, and going northward from this point there is less and less of it to be seen, until, in the vicinity of Stockton, in the centre of the State, the predominance of other varieties is complete. From Fresno to Madera, two-thirds of the wheat is Sonora, the other third being mostly White Australian, as it is called there—White Lammas, as we call it. In this part of the valley, as far north as Merced, much barley is grown for hay. I was in fields of good White Tuscan,

Crossing the river, San Joachin Valley. The flat nature of the valley is well shown; many miles of country on the farther bank appear as a very narrow streak. Near the middle of the horizon appears a single tree, many miles away.

near the town of Ceres, but this variety is little known. From Merced to Lathrop it is occasionally seen; but so far as I could judge from the seasons in which I saw it, this variety would stand below their White Australian, *i.e.*, our White Lammas.

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At Stockton, and from there to San Francisco, White Australian and Club predominate. Here, also, considerable bearded wheat is grown, partly with a reddish grain, and partly with a whitish grain. The latter I made out to be our Early Baart, of which we formerly had a strain under the name of Stockton Defiance. Both these bearded sorts grown about Stockton are early. The Club, of middle California, is our Little Club, unmistakable in its short even growth, good straight straw, small crowded heads, and small crooked unsymmetrical grain. It has a very good name with the Californian millers.

Drawing of Australian Talavera, one of the Australian wheats most nearly resembling the so-called "White Australian," of California. The ear is shown cut in two near the middle, so as to allow the top half to be turned a little, and thus give both profiles in one view. The grains are shown full size, the lower being seen from the back, the middle one from the side, while the topmost is seen in cross-section. The drawings were made from average specimens.

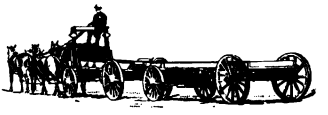
Drawing of White Tuscan wheat (the White Tuscan of the Australian Wheat Nomenclature Committee). The ear is shown one-half size; the grains are shown full size, the lower being viewed from the back, the middle one being viewed from the side, while the upper one is viewed in cross-section. The upper half of the ear is cut loose and turned quarter way round so as to show both profiles in one view. The drawings were made from carefully selected average specimens.

I did not see a single late variety of wheat growing in Californian fields, from which it may be inferred that they are almost never grown.

The reason that the varieties thus far noticed are preferred to any others is that the nature of the climate of the San Joachin Valley demands a quick-growing wheat that will stand heat and drought, and the experience of the growers there has caused them to place these varieties above all others they have tried; and their location in the valley would further place them in the following order as quick growers and heat resisters: 1. Sonora (Velvet Pearl); 2. White Australian (White Lammas); 3. Club and the others (Little Club, Early Baart, etc.).

Drawings of "Early Baart" wheat. The ear is cut in two and the upper half turned way round so as to show both profiles in one view. The grains are shown full size. The lower grain is seen from the back, the middle grain is seen from the side, while the upper grain is in cross-section. The ear is shown only half size.

The case of Sonora is instructive. As I have just said, its flour is not of a popular colour, and the grain is docked 50 cents to a dollar per ton; but, in spite of these facts, it is very largely grown. The following are among the reasons for its prevalence, in addition to the reasons already given: it is a heavy sort, that is, its weight per bushel is great; and it makes a readily marketable whole-wheat flour. I was informed that a good proportion of the Sonora milled in California is



Method of hitching waggons in a train, peculiar to the Pacific coast.

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ground into whole-wheat flour. For export purposes the fine appearance and heaviness of the Sonora grain are found to be good selling-qualities, and a ready foreign market is established for it at satisfactory prices.

Sonora is also grown in the dry parts of Utah, Colorado, and Arizona.

The method of growing and harvesting wheat in California is peculiar, and demands that the variety shall stand up well, and hold its grain after it is ripe for a period of six weeks if necessary. This fact, of course, has much to do with the selection of varieties. * *

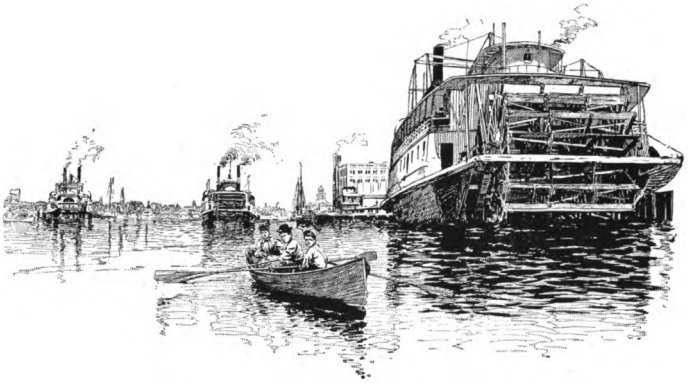
"A ready foreign market is established for it at satisfactory prices."

Grain of Velvet Pearl or Sonora Wheat. The small plump character of the grain is well shown. (Full size.)

"At Stockton I visited the grain-markets and a number of mills. The electrics take you there—if you know how to work them.

"Why doesn't some one invent an automatic announcer of destinations for the use of electric trolleys and railways? What I want is an infallible device that will bob up in front of me and quietly announce in unmistakable type that the next station is Smithfield. I'm tired of craning my neck and grabbing after the time-table to find out what it is the officials are supposed to be saying.

"Brimfield, Bojarrah, Podham, and Thimble—those names do not sound much alike. Yet I've travelled past stations named like that for years without



'These boats do an immense trade between the two cities.'

finding out what it is the officials sing out when the train stops at those places,—it's the same thing at every one of them, that's the only point I'm certain about. When I want to know where I am I either hunt up the station-sign or ask a fellow-passenger.

"The psychology of this subject of loud pronunciation needs to be monographed. Why is it that a man who has yelled 'Bangville' for a year gets to saying the same thing as the man who yells 'Pipton' at the next station?

"I simply wanted to go to the wholesale grain region. I secured the morning paper and climbed aboard, and the trolley moved off. 'He'll call out when you get to the wharves,' I was told, so presently I began to give heed to the announcements. The driver shut off the current, turned on the brake, and the car came to a stand-still; the conductor bawled out:—

"'Bedavy! Bedavy! mixed up with Baptis way!'

"'What's that?' said I.

"'Mixed up with Baptis way!' snapped he.

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"I turned to my next neighbour and asked, 'What was it he said?'

"With a grin my neighbour replied, 'I don't know. Where is it you want to go?'

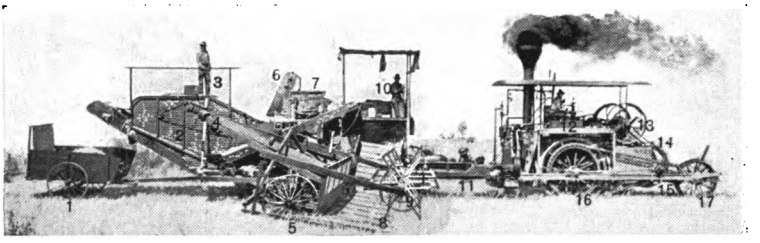
"'I want to go to the grain markets.'

"'Oh, that's a long way yet. You don't get out till after I do.'

"This made me comfortable enough so that I sat back and glanced through my paper. The conductor meanwhile went on concealing his meaning in loud tones. At last my neighbour arose, bade me good day, and disappeared, and my troubles began afresh—at least so I thought. However, the next proved to be 'Right Square and Every Avenue!' This was such an obviously safe place at which to get out that I concluded to take the chances, and so dismounted. It happened I was not far wrong, and I was soon among the dealers and millers."

Most of the wheat raised in the San Joachin Valley finds its way to Stockton, all of it in bags of light quality, holding about 100 lb. each. It is stored, handled, and sampled, without removal from the bags. This means an enormous amount of hand lifting and hand trucking at wages averaging at least six shillings a day. Comparatively little machinery is used to facilitate these operations. The bags of wheat are received at the grain-stores from waggons and are weighed tediously about five at a time, and then hand-trucked and hand-lifted into piles, the operation being reversed on delivery.

Many farmers and dealers are fully aware of the advantages of the bulk system, but sailing ships running round Cape Horn have long been the ruling factor in the Californian grain trade, and they still carry the day. Signs are not wanting that the bulk system is gaining in favour, and we may look in the not distant future to see California follow the lead of the other Pacific Coast States in adopting it. It is already in use in the Californian flour mills.



Side view of right-hand of "Holt" Steam-traction Combined Harvester, at work on wheat near Stockton, California. At the moment of taking the photograph the machine was moving forward at the rate of 3½ to 4 miles per hour, and all the operatives were at work at their stations. 1, Straw-cart; 2, thresher; 3, man who looks after the thresher and cleaner and dumps the straw; 4, frame-work and weights by means of which the cutter-bar (8), and reel (9), are so pivoted over the wheel and axle (5) as to be easily moved up or down by the operative (10) to suit the height of the crop. The machine was at the moment passing through very light crop, and the apron can be well seen, being nearly empty of wheat; 5, wheel and axle supporting the cutter-bar and reel and their counterbalancing framework (4); 6, elevator bringing up wheat to the cleaner from the thresher; 7, top of cleaner; 8, cutter-bar and apron; 9, reel; 10, steersman for the cutter-bar; 11, fireman "having a loaf"; 12, engineer; 13, fly-wheels on the main shaft; 14, main driving-chains; 15, steel-girder frame of traction engine; 16, traction-wheel; 17, guide-wheel.

Meanwhile creepers are being proposed, and in at least one case are to secure a trial. While it is admitted that the creepers are slower and more expensive than the belt carriers of the bulk system, it is hoped that bags will be handled in this way more cheaply than on hand trucks. The creepers do not do away with the stacking and unstacking by hand.

The creeper is an endless band made of wooden slats and actuated by sprockets,—the same appliance that is used to deliver cane at our sugar mills. It can be used to transport other merchandise. I saw it in use at Liverpool

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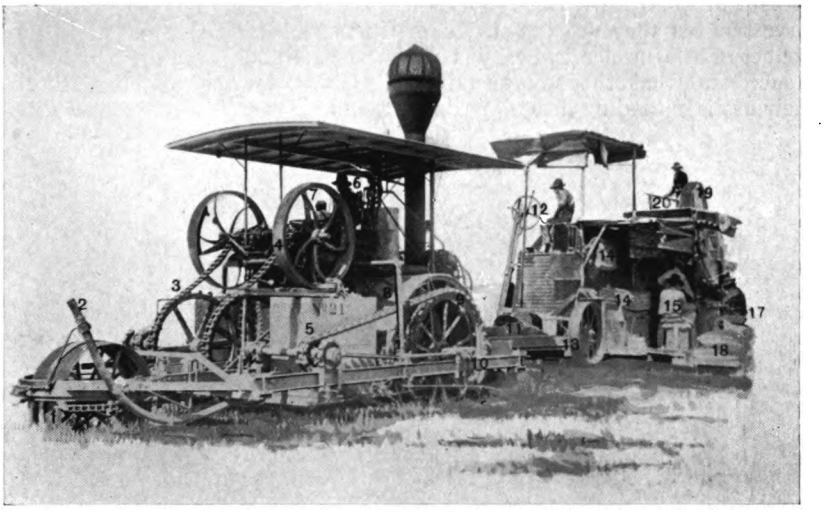
to move passengers' luggage and other merchandise from the dock to the store-house. I saw no grain handled in this way at Liverpool, elevators being preferred. In case of the creeper the bags of grain have to be lifted on to the creeper, and carried away by hand at the delivery end.



Perspective view of a "Holt" combined steam-traction Combined Harvester in operation near Stockton, California. At the moment of taking the photograph the machine was moving forward at the rate of 3½ to 4 miles per hour, and the men were at their stations and performing their work. 1, guide-wheel, worked by means of horizontal sprocket-chains, one of which is shown; this wheel is turned in its circular horizontal frame by means of these chains; 2, water-pipe, by means of which the tender supplies the engine with water; 3, one of the two main drive-chains; 4, one of the two fly-wheels, each located on an end of the main shaft; 5, tank; 6 engineer or driver; 7, fireman; this man is at present off his station,—"having a yarn" with the engineer—his station is on the platform, near the coal-bags (11); 8, one of the traction-wheels, the tire on which this figure is placed, being 3 to 4 feet wide; 9, traction wheel sprocket, driven from 5; 10, steel-girder horizontal framework of the engine; this number is placed near the axle of the traction wheel; 11, bags of coal; 12, wheel by means of which a special operator keeps the cutter-bar at the best level, such level varying with the height of the crop:—it is in order that this wheel may act easily that the cutter-bar and reel are counterpoised with weights; 13, fly-wheel on the main shaft of the auxiliary engine used to drive the cutter bar, threshing machine, and cleaner: this auxiliary engine is on the main engine rear-platform, the connection with 13 being by means of a Hooke's joint; 14, empty bags; 15, man sewing bags; 16, man filling bags; 17, another man sewing bags; 18, bags of wheat on platform ready to be dumped; 19, top of the elevating belt which brings the grain from the thresher to the cleaner; 20, man who looks after the thresher and cleaner and dumps the straw.

Conversing with a miller and grain dealer at Stockton, California, I was informed by him that he had no difficulty in distinguishing among the different varieties of wheat that came into his market, providing they were fairly pure samples. As will have been inferred from the preceding pages, six to eight varieties are prevalent in that market.

This gentleman gave samples of his skill, and named Sonora, Club, White Australian, and others, correctly and without hesitation. The samples were of the grain alone, and were of my selection. Though I have no reason to suppose such skill to be uncommon, according to my observation the majority of dealers and millers would fail in any severe test of this sort.

After the blazing heat of the San Joachin it was a relief to take one of the stern-wheel river boats for San Francisco. These boats do an immense trade between the two cities. They take the traveller through flat country largely devoted to wheat, in which numerous steam harvesters may be seen cruising back and forth. I stopped and looked at the great reclaimed swamps where

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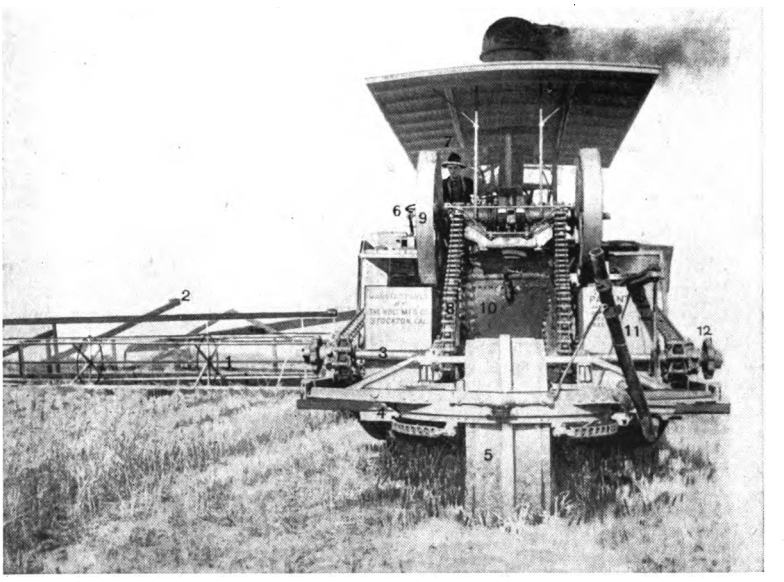
enormous quantities of high quality celery are grown by peculiar methods. It was a lesson well worth learning, and one which on another occasion I hope to describe in these pages.

Any attempt to extract, from Californian methods of wheat-culture, suggestions useful to Australians must take into account the peculiar methods of harvesting, the essential feature of which is the use of combined harvesters, as they are called. These huge and expensive machines are a product of the mechanical genius of the Californian inventor, and they are so successful that they are in universal use in lower and middle California. Their use is extending into all parts of the Pacific Coast where the conditions



Front view of a "Holt" steam-traction Combined Harvester in operation harvesting wheat near Stockton, California. The machine is moving forward at the rate of 3½ to 4 miles per hour. 1, reel, 24 feet long, in character entirely similar to that of the ordinary reaper and binder: under this reel the cutter, 24 feet long, flies back and forth precisely as in a reaper and binder; 2, framework at the back of the cutter-bar to balance the weight of the reel and cutter-bar; 3, secondary shaft, which drives the big traction wheels (these latter are not to be seen in this photograph); 4, horizontal steam-girder framework: near 4 is seen one of the sprocket chains used to steer the machine by twisting the wheel 5; 5, single front guide-wheel, by means of which the machine is guided—this wheel is turned to the right or left by means of the horizontal sprocket chains shown to right and left respectively: these chains are worked by the engineer; 6, engineer's right hand on the lever which works the guide-wheel; 7, engineer; 8, one of the two main driving sprocket chains; 9, one of the two fly-wheels on the main shaft—midway between these two fly-wheels may be seen the crank; 10, boiler-plate; 11, tank; 12, sprocket wheel on secondary shaft, here not in use: used when extensions are put on to the main traction wheels.

are suitable, namely, those parts where the grain can be allowed to thoroughly ripen before harvesting. The fact that much of the wheat grown in Australia is produced under precisely such conditions as this makes an understanding of these machines worth something to us on this side of the Pacific. I will, therefore, give the impressions I gained from spending several weeks on and among these machines while in operation in the field during an ordinary season.

There are several makes of these combined harvesters. The "Holt," the "Best," the "Haines-Houser," the "Mathieson and Williams," are all well known makes. As the machines cost from three hundred to eight thousand.

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dollars each, and as towards two thousand horse-traction and two to three score steam-traction machines are in use, it will be at once seen that the capital represented runs into no small figure. I presume it is fair to say that a million dollars of farmers' money is invested in these combined harvesters in California alone, and I saw no evidence that the machines are on the wane; on the other hand, I saw considerable evidence that they are on the increase. I believe that the use of such machines is in its infancy, and that the near future will see machines of this type—*i.e.*, the complete type of harvester in which the grain is cut, threshed, and cleaned ready for the mill—made smaller, cheaper, and otherwise much improved, and widely adopted in localities where the harvest weather is dry. In fact, after an

Rear perspective view of a "Holt" steam-traction Combined Harvester at work near Stockton, California. At the moment of taking the photograph the machine was moving forward at the rate of 3¼ to 4 miles per hour, and the crew were all at their stations and at work. 1, water-pipe used to fill the engine-boilers; 2, one of the two main fly-wheels; 3, traction wheel; 4, bags of wheat on platform ready to be dumped; 5, group of three baggars; 6, bag in process of being filled with grain; 7, steersman for the cutter-bar (barely to be seen); 8, grain cleaner; 9, elevating belt bringing grain from the thresher to the cleaner; 10, threshing machine; 11, man who attends the thresher and cleaner, and dumps the straw from the cart (13) by means of the cord at his right hand; 12, straw issuing from rear of thresher; 13, straw cart, to be dumped periodically; 14, cloth flap to prevent straw from falling out rear end of straw-cart.

examination that was in no manner hasty or superficial, I found myself, while much admiring the enterprise and ingenuity of the Californians in this matter, compelled to regard even the most improved and up-to-date of their harvesters as in reality crude and unwieldy. I am not now speaking of the traction engine which they employ to drag the harvester, but of the harvester itself. Build a huge mowing-machine large enough to carry a full-sized threshing machine and a cleaning machine, then mount these latter on the mower, and gear them together somehow, and you have the combined harvester—a monster affair that requires twenty to thirty horses to drag it over the field. And yet, crude as they are from the scientific point of view, they are successful commercially. With ready access to the best reapers and binders at a low cost the Californian prefers to buy the combined harvester. The lesson is obvious! We have here the forerunner of one of the important harvesting machines of the future!

When invention has brought the various parts of this machine into better harmony with each other and reduced the size and cost—in doing which it will only be repeating the history of the mowing machine and the reaper and binder—there will emerge the harvester of future generations. Replace it's bagging arrangement by a bulk receiving and discharging arrangement, and thus reduce its crew by one-third, and it will be by far the cheapest harvester

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in existence, considering the work it will do. Of course, as before remarked, these harvesters are suited only to such localities as have sufficiently dry harvest weather to allow of permitting the grain to ripen well before harvesting.

The general appearance of the "Holt" machines is very well shown in the accompanying illustrations, pages 1328–1331, where the machines are pictured in actual operation with every man at his station and doing his work. The photographs are completely lettered and described on the four previous pages, so that little else is needed in this place beyond a general description of the principles of the machine and a reference to the interior parts not shown in the pictures.

The fuel used is New South Wales coal, and not straw, as was the case formerly; about two tons of coal per day is consumed by a twenty-seven-foot machine harvesting twelve hundred Californian sacks per day on fairly heavy land. The coal and water are brought to the harvester as required by a tank-waggon, having a platform for coal. The rapid fall in the price of oil makes it probable that this fuel will replace coal on the harvesters, just as it has already replaced coal in many Californian manufactories. The engine pumps its own water into the boiler through the hose shown in the illustrations. The hood on the engine flue is efficient, and fires from flying sparks are almost unknown. Much care is exercised with the cinders, the fireman having a commodious platform for his work.

Each steam-traction machine has two engines—the main engine driving the traction gear, and a vertical auxiliary engine placed on the rear platform of the traction engine and connected with the harvester by means of a Hooke's joint.

The main shaft of the harvester is placed longitudinally, and by a bevel-gear drives the large pulley seen near the sacking-platform; this in turn drives the forty-inch peg-drum of the thresher.

Foregathering for lunch. The near machine is stationary, and the crew dismounted and gone to lunch The machine in the distance is coming in. 1, portable commissariat, kitchen, and dining-car; 2, tender for the machine coming in, crew and horses at lunch; 3, rear end of tender of near machine, showing bags of coal and water tank; 4, traction-wheel tire, 5 feet broad; 5, dumping platform for bagged grain; 6, elevator for conveying grain from the thresher to the cleaner; 7, thresher; 8, reel, cutter-bar, and counter-poise. These machines are "Best" machines.

The apron delivers the cut grain direct to the thresher. The cutter-bar is like that of the ordinary reaper, except that its large size (it is sometimes forty feet long) compels the use of special steering gear. By means of large beams and weights the cutter-bar is pivoted, so as to be easily tipped on an axis that clears the stubble, and the tipping raises or lowers the cutting-knife. The steering wheel I found to work very easily, and from the station of the operator it is easy to see, and allow for, any unevenness in the crop.

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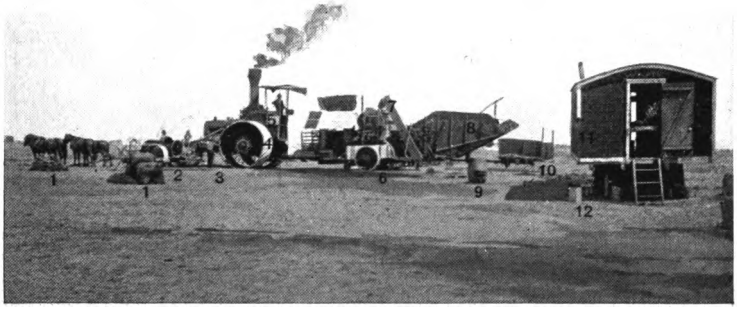
The threshing, cleaning, and bagging arrangements present very little so peculiar as to require special mention. The machines are in detail the same as the ordinary make of American thresher and cleaner, and are mounted on a platform and connected. One of the crew is stationed aloft and tends these two machines, keeping the riddles clear of rubbish, and dumping the straw-waggon periodically. This latter operation he performs by pulling a rope



Watering up just after lunch. "Best" Steam-traction Combined Harvester, tender, and travelling kitchen. 1, bags of coal; 2, 4-horse tender in the act of supplying water to the traction engine; 3, fireman; 4, traction wheel; 5, engineer; 6, dump-cart for the bagged wheat; 7, elevator; 8, thresher; 9, barrel of drinking-water; 10, dump-cart for straw; 11, travelling kitchen; 12, the ubiquitous kerosene tin.

connected with the straw-waggon. This dumps the straw in a pile on the ground, whence it is taken away for fodder, or, if not, then in some cases burned where it lies.

The full crew for a twenty-seven-foot harvester consists of the afore-mentioned cutter-bar pilot, and the workman just mentioned as looking after the thresher and the cleaner, and the sack-men. These latter are two or three in number, according to the crop. With a light crop two may answer, but with a good crop the work is heavy for three. The bags are hung in place at the two spouts, and when full are removed. This is the work of one man. The other two sew up the bags and lay them on to the dumping board, from which they are dumped periodically in bunches of about half-a-dozen.

The combined harvester is difficult to clean, and must be responsible for the spread of much weed-seed and disease.

Turning now to the traction engine, we find the piston driving a main shaft arranged transversely, with a fly-wheel on each end. Two small sprocket-wheels on the main shaft drive a pair of large sprocket-wheels below and in front, the shaft carrying these latter carrying also a pair of small sprockets which drive the traction wheels by means of the largest sprocket chains shown in the illustrations. The Holt patents hinge on the combinations of this system of sprocket wheels and chains.

The engine is steered by the engine-driver, who can, from his seat near the throttle-levers, work the steering chain to be seen horizontally encircling the single front wheel. The horizontal hand-steering wheel is at the engineer's right hand, as is also a steering lever, which acts by throwing the steering gear in and out of action. Both these grips are shown near the engineer's right hand in the illustration on page 1330 (6).

The traction is by a single coupling, and the speed is three to three and a half miles per hour, which, with a twenty-four to twenty-seven-foot cutter,

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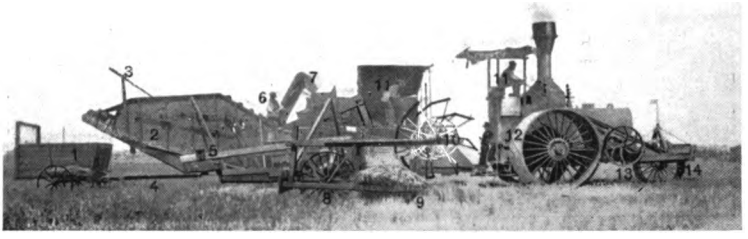
means the harvesting of at least eight acres per hour. Long runs have been made with such a machine, averaging ten acres per hour. It is claimed that one and a quarter to one and a half tons of coal per day is sufficient. My observations, however, gave about two tons.

The tires of the engine traction-wheels are upwards of three feet wide. The Holt machine is manufactured at Stockton, California.

It is very instructive to note that the history of these traction engines has shown a constant widening of the traction tires, and there is no indication



Side view of a "Best" steam traction Combined Harvester in operation on country to the south of Stockton, California. At the moment of taking the picture the machine was moving forward at the rate of 4 to 5 miles per hour, and the crew were all in their places. 1, dump-waggon for straw, dumped by means of the lever (3); 2, thresher; 3, lever for dumping the straw-waggon (1); 4, tongue of the straw-cart; 5, framework and weights by means of which the cutter-bar (9) and reel (10) are counterpoised over the wheel and axle (8); 6, man who tends the thresher, cleaner, and straw-cart; 7, elevator which brings the grain up from the thresher to the cleaner; 8, wheel and axle on which the cutter-bar is so pivoted that the operator (11) can easily raise and lower it to suit the height of the crop; 9, end of the cutter-bar; 10, reel; 11, man who steers the cutter-bar; 2nd 11, engineer, steering by means of an oblique axle: the fireman is shown below, leaning against the boiler; 12, traction wheel; 13, one of the two fly-wheels on the main shaft 14, guide-wheel.

that the maximum useful width has yet been reached. The great weight of the machine sinks the tires so deeply into sand and soft soil that tires of immense width are now being constructed in the hope of developing a machine that will serve in sandy desert country. Such a traction machine would be invaluable. As it is, these machines are constructed to work on country that would be dangerous or even impossible to horses on account of softness, or on account of deep and wide cracks due to the drying up of deep alluvial soils.

The "Best" traction engine, another leading make, is built on quite a different plan, gearing being used instead of chains and sprockets. It is an efficient machine, of high speed. The pistons drive a main shaft, whose two small gears drive two large gears on another transverse shaft, which in turn bears a pair of small gears, and these latter drive an inside cog on the rim of the two traction wheels. Provision is made, as in other machines, for extending the tires by means of wooden additions. In this manner the tires may be made seven feet wide. In the case of the "Best" machine, the auxiliary engine is placed on the harvester, and is supplied with steam through a coupling of flexible steam-pipe.

The "Best" machine is manufactured at San Leandro, California.

The firm of Matthieson & Williams, of Stockton, make excellent combined harvesters of all kinds. One of the members of this firm is said to have been the first to conceive and execute a combined harvester.

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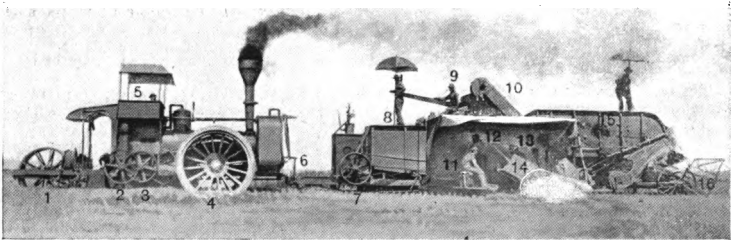
Labour on these machines costs about three dollars per day. The work, though for the most part light, is often disagreeable. The engineer receives three and a half dollars to four and a half dollars per day. The day's running expenses may be summed up thus:—Engineer and crew of seven men and boy, including tender, 25 dollars; seven thousand five hundred-dollar machine, good for five years at sixty days' run each year, 25 dollars; interest and repairs, 6 dollars; coal, 10 dollars; total, 66 dollars per day. This takes no account of the use to which the traction engine may be put in the spring, when it is usually used in ploughing. As in this case it is wearing out very little faster than it would "rust out" if lying idle, this estimate might with reason be considerably lowered.

At one thousand bushels per day, this brings the cost of harvesting, cleaning, and bagging down to about three pence per bushel, not including cost of bags! This low figure is actually reached under good conditions, but it is seldom that a full sixty days' run is secured, and when the harvest is light the figures are very different.

The steam outfit is always accompanied by a travelling commissariat. This consists of a kitchen on wheels, food-waggon, cook, and messenger. The steam harvester gets over the ground so fast that the distance between the locations of the kitchen on the morning and evening of the same day may be several miles. The kitchen, which is also dining-room, is about eight feet wide by twenty feet long. At meal time board tables, and seats rest across the room. If one occupies a table near the centre of the room this sometimes involves considerable crawling in and out, and over and under as a penalty for being late at meals. I found the fare and utensils to be about the same



Side view of a Williams and Mathieson steam traction Combined Harvester at work on wheat in country to the south of Stockton, California. At the instant of taking the photograph the machine was moving forward at the rate of 3½ to 4 miles per hour, and all the crew were at their places and at work. 1, guide-wheel; 2, wheel on main shaft; 3, secondary shaft, driving the traction shaft; 4, traction wheel; 5, engineer—below him, and above 2, may be seen the fireman shovelling in coal; 6, steam-pipe passing over to auxiliary engine on the harvester; 7, fly-wheel on main shaft of the harvester; 8, steersman of the cutter-bar, which, on this machine, is worked by the long lever shown; 9, machine tender; 10, elevator bringing up grain to the cleaner from the thresher; 11, 12, 13, baggers; 14, dump-cart for the bagged grain, being dumped; 15, thresher:—above this figure is shown the operator who dumps the straw; 16, straw-cart, being dumped.

as at Australian shearers' sheds—substantial and plenty, but plain and rough, with no great variety, except in the way of picturesque language. Being a kind of visitor and a "tenderfoot," I am not sure that I was not treated a little better than would otherwise have been the case.

None of the combined harvesters so far produced will work in damp weather, nor will they work in the early morning if there is any dew present, or even a moist air. These machines are quite as sensitive in this respect as the Australian stripper.

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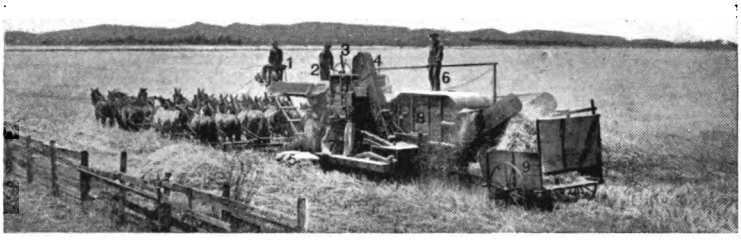
All the harvesters leave eight to twelve inches of stubble.

The prices charged for harvesting by owners of steam outfits I found to be fourteen cents to seventeen cents per Californian sack.

I found that the machines had to be slowed down considerably on land no rougher than much of that to be met with at harvest time in Australia. As with other harvesting machines, so with this, the smoother the ground the better the speed. Large clods seemed to me to constitute just as serious an obstacle to fast work with these large combined harvesters as would be the case with an ordinary reaper and binder.

By far the greater number of combined harvesters, of every make, are drawn by teams of twenty to thirty mules or horses. The animals are arranged as shown in the diagram on page 1340. The driver, as shown in the various illustrations, sits on a seat arranged well out over the hind tier of animals, and has reins connected only with the front pair. This pair of leaders must be well trained, reliable animals. They are placed either somewhat or altogether in advance of the others. Very often they are let out a



Perspective view of an animal-traction "Holt" Combined Harvester, drawn by 24 mules and horses, working on wheat in country to the north of Stockton, California. At the moment of taking the photograph the team was moving forward at the rate of about 3 miles per hour. 1, driver mounted on an oblique ladder which reaches out over the hind tier of animals; 2, steersman for the cutter-bar; 3, wheel by means of which the cutter-bar is guided; 4, elevator bringing up grain from the thresher; 5, bags of wheat lying on the dumping-board ready to be dumped; 6, man who tends the thresher, cleaner, and straw-dumper; 7, bag being filled with grain; 8, thresher; 9, straw-dumping cart. The baggers are hidden in the dust near 5 and 7.

yard or so only, being the two middle animals of the leading tier of six or four as the case may be. In each tier the animals are led by a chain from the bit to the shoulder of one of the adjoining animals. A long whip and pebbles are the main stimulants used by the driver, if we except "language." As a rule, these teams are treated gently; they are too large and unwieldly to risk provoking. When well handled, they go along with great steadiness, and serious accidents are uncommon.

The ordinary animal-traction combined harvester is driven by two broad-tired wheels after the manner of an ordinary reaper and binder. As, however, the number of these machines now in use in California is nearly sufficient to cope with the level areas under wheat, the manufacturers have turned their attention, with no small degree of success, to the building of machines of the combined type suitable to side hills. In these side-hill machines the driving power is a *single* wheel, on which the whole structure rests, and rocks, or varies, to suit the varying inclination of the slope being harvested. In recent years the manufacture of these machines has increased considerably. In consequence of the success of these machines, the wheat area of California is gradually spreading over the foot hills on both sides of the San Joachin Valley.

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All these animal-traction machines require the same crew as the harvester portion of the corresponding size of steam traction machines. They average to be smaller in size than the steam-driven machines, the cutter-bar varying from eighteen to twenty-four or twenty-seven feet. They are usually owned by wheat-growers for use on their own premises, while the steam outfits are often owned by travelling harvest-men who engage to harvest on various farms at so much per bag.

In order to see the wheat industry in all parts of the valley I crossed it from west to east in Merced County, and climbed into the heart of the Sierra Nevada Mountains.

In the middle of the valley the Sonora wheat prevailed, and the ordinary combined harvester moved along the even tenor of its way; as we approached the foothills, more Club and White Lammas was to be seen, and in the foothills themselves the side-hill harvester was seen moving calmly across incredibly steep slopes.

"And climbed into the heart of the Sierra Nevada Mountains."

"Climbing through the orchard region of the lower slopes and up into pine regions, following a tortuous road that led along the edges of deep cañons and past the feet of stupendous precipices, I reached the top at last, and then was whisked down into the valley below by a driver who boasted that he had known Hank Monk.

"The name and exploits of the famous stage driver, Hank Monk, fill the Sierras. The tales that are told of his never-failing skill and punctuality have whiled away endless hours as the horses toiled slowly upward. Hank Monk has been dead a long time, but all present-day drivers knew him personally; at least I never found one of them to deny his acquaintance if approached skilfully on the subject. No driver's reputation could be expected to long survive the reproach of not having known Hank Monk.

"I was one day being driven through the Sierras, the sole passenger with a driver who, as usual, had known Hank Monk. The load was light and we bowled along at a pace that took little account of narrow roads or sharp curves, or ruts, or stones, or fallen trees. Talk about sharp curves! Much of the way the leaders, if they had tried, could not have seen the hind wheels.

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And narrow roads! If you just missed going off into the cañon it was reckoned as good as a mile. The whole road was constructed on that principle!

"With monotonous regularity the leaders missed the cañon's edge by a foot or two as we rounded each point, and left hoofprints at the foot of the bank as we doubled the head of each gully. The pace never slackened except when we climbed some long hill. We boomed along, taking risks enough every hour, it seemed to me, to last a professional balloonist a lifetime. I wondered what would happen if we should meet anyone. Personally, if I had been walking on that road and had met a team going at our pace I should have taken to the nearest tree as the safest place.

"Suddenly through the trees we caught sight of a four-horse team not over a hundred yards away. Our own noise had prevented our hearing what turned out to be an empty waggon, on the high seat of which was perched the regulation mountain teamster. It appeared he had yelled at us without effect. Our pace was such that we were up against this big team by the time it was possible to stop on the steep down grade we were traversing.

'Much of the way the leaders, if they had tried, could not have seen the hind wheels."

"Here was a situation! There was no room to turn round, and there was not room on the road to pass! The cañon yawned on one side a thousand feet or so deep. On the other side the mountain rose with characteristic precipitousness.

"Each driver looked at the other in silence. When they did speak neither was profuse in apologies. After various 'amenities' the partner in our contretemps agreed to try driving by us if we would move our vehicle over as much as possible. Accordingly we lifted the coach up on to the bank until it seemed as if another inch would upset it; fortunately the horses remained quiet. Without descending from his high perch the teamster coolly drove past us. His hind wheel caught ours by about half an inch. We lifted the coach another half inch, and hung on to it until the waggon was past.

"The teamster drove on, never turning to give us the slightest further notice, and was out of sight in less than half-a-minute round the next curve. I crossed over and examined his wheel tracks. He had driven within about four inches of an edge, to have crushed which would have sent him down a steep cañon hundreds of feet deep! My driver's only remark was to the effect that I ought to have seen Hank Monk do a bit of driving like that. He would not have gone bumping into other people's hubs for the sake of saving a paltry half-inch when there was room to spare.

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"Great was Hank Monk! All mountains have their celebrities. The Alps have their William Tell, the Catskills their Rip Van Winkle. The Sierras have Hank Monk."

This skill in the management of teams comes into play on the combined harvester. The driving of two to three dozen animals with sufficient accuracy to secure good results with a cutter-bar, the turning of square corners with such a team, the regulation of its speed, its control when under the influence of fright, are matters that call for no little skill and judgment, of a kind found abundantly only among people having a genius for horses, such as the Californians or the Australians.

The tackling up of one of these big teams varies according to circumstances, but is something as follows :—The animals are placed in tiers of six, each tier being arranged in pairs. The size of tier is fixed very largely by the

Front view of an animal-traction "Haines-Houser" Combined Harvester working on wheat near Merced California. At the moment of taking the picture the team was moving forward at the rate of about 3½ miles per hour. The driver's lines connect only with the foremost pair of animals.

width of the machine. The main whiffle-tree carries three subordinate whiffle-trees, each of which in turn carries a pair of single whiffle-trees. This is the arrangement of the "wheel" tier. A chain passes between each wheel pair and goes forward for the animals in front. These latter are hitched in pairs to double whiffle-trees, and are also hitched in tiers of six. This arrangement is repeated through three to five tiers, according to the size of the machine to be drawn. The front tier is different from the others ; the middle pair are given a few feet of lead or an additional pair of leaders supplied. The whole team is therefore a multiple of six—or a multiple of six, plus two. Eighteen is a common number for the smallest size of harvester—three tiers of six, the front tier of six having its middle pair somewhat advanced. Thirty-two is a common number on the larger harvesters—five tiers of six with a pair altogether in the lead.

There is only one pair of lines,—these are for the leaders. The team is held together by leading chains from the strong bridles of some of the outer animals to the tackle inward and to the front of them.

The driver's seat is rigged well out over the hind tier of animals and is high enough to secure a good view of the whole of his team. The tools of

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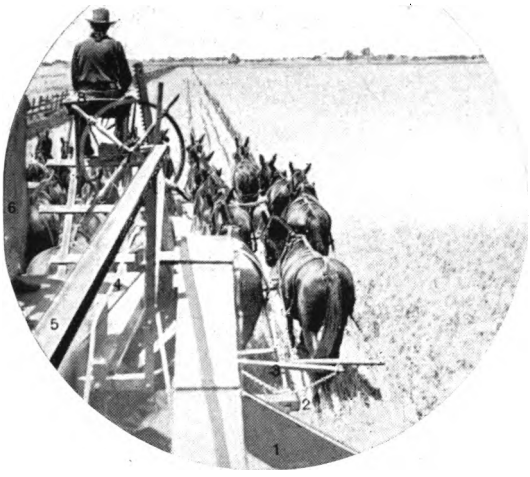
his profession are the single pair of lines before mentioned, a long whip, some pebbles, and "language." His vocation seems sufficiently dangerous, when we consider the nature of the machinery behind him and the irresponsible herd in front of him. Runaways do occur, but are not frequent. Some machines are arranged so that as soon as the speed reaches a certain point the machinery is thrown out of gear automatically, thus preventing the most serious damage in case of a runaway.



View from the top of a small animal traction Combined Harvester of the "Holt" pattern, in operation in the country to the north of Stockton. At the moment of taking the photograph the machine was moving forward at the rate of 3 to 3½ miles per hour, being drawn by twenty-four horses and mules. 1, apron frame, behind which the wheat is coming up from the cutter-bar to the threshing machine; 2, end of main swingle-tree; 3, secondary swingle-tree; 4, top of thresher, used as a floor by the crew; 5, guard-rail to floor for safety of the operators; 6, steersman for the cutter-bar, who works the wheel (7); 7, wheel for raising and lowering the cutter-bar; 8, driver.

A most valuable lesson in wheat culture may be learned by comparing the data set down in the foregoing pages with the rainfall maps of the United States Weather Bureau, lessons all the more valuable to Australia because the varieties of wheat grown in this country are to all intents and purposes the same as those grown in California.

From observations extending over twenty-seven years, maps have been prepared showing the annual rainfall of the United States of America, as well as the distribution of this precipitation in time and in space. Turning to the Pacific Slope we find the western part of Southern California to receive from nothing to five inches of rain annually, a quantity too small for agriculture unassisted by irrigation. A peninsula of this dry area extends into the central part of the state, north of Los Angeles, and represents the Mojava Desert, mentioned in the letter quoted on page 1322. Beginning at this portion of the dry area and extending northward along the San Joachin River is a strip of country fifty miles wide, reaching as far north as Merced, that receives annually from five to ten inches of rain. This is the central portion of the San Joachin Valley, characterised by flatness and

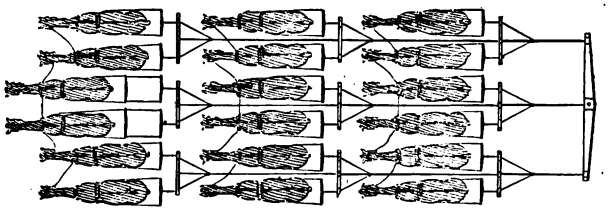


Diagram of the usual manner of "tackling up" one of the teams of animals used to draw a combined harvester.

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absence of vegetation under natural conditions, except at certain seasons and near the river. Here irrigation has created Fresno and other wonders. To

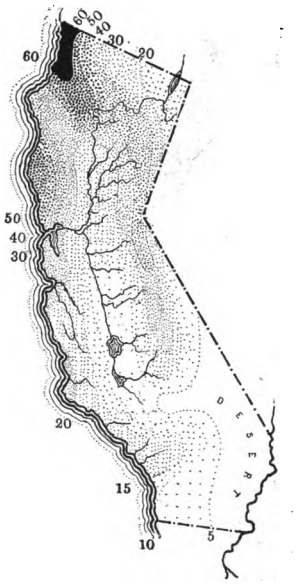
Steam-traction combined harvesters cruising in a sea of wheat beyond Stockton. View from the dome of the Stockton Court-house.

the east and west of this fifty mile strip the rainfall increases to fifteen or even twenty inches per annum, this latter figure being reached for the most part in inaccessible mountains, unsuited to wheat-growing. The fifteen to twenty inch area extends northward however, into the valley of the Sacramento River.

Maps indicating how this rain is distributed during the year show that practically all of it falls between October and April. It is necessary to bear this in mind in order to understand how wheat can be grown in California under so small an annual rainfall.

An examination of the accompanying copies of the official maps will show that even where the annual rainfall is so low as ten to fifteen inches wheat is grown regularly. This is possible only when the rain falls punctually at certain periods of the year. These conditions are fulfilled in the San Joachin Valley, where the rain, as before mentioned, is largely confined to six months out of the twelve.

One sees by the map how regularly the precipitation diminishes as one goes from, say, Stockton toward the Mojava Desert. Just as regularly one sees the "Club" wheat of Stockton replaced by the "Lammas" of Merced, and the latter by the "Sonora" of Fresno. The traffic up and down this valley is a busy one, and the people mingle freely, while ideas and varieties spread with equal ease and rapidity. When we take all these facts into consideration there seems to be but one conclusion possible, viz.—the order of the varieties exhibited in the San Joachin Valley is the expression of a natural law of adaptability, and that of all the varieties yet tried by the Californians the Sonora is that best adapted to stand a dry and hot season following on the minimum winter rainfall that will ensure a crop.



Map of the average annual rainfall of the State of California. The portion left white and marked "desert" has less than five inches of rain per annum. To the northward the rainfall is shown as it increases by fives, the black area at the extreme north having sixty inches per annum It will be noted that the ten to fifteen inch area extends as a long and narrow peninsula along the valley of the river toward the mark forty, which represents the location of the city of San Francisco. This river is the San Joachin River, so often mentioned in the text. This and the three following maps have been prepared from data supplied by the Weather Bureau of the United States.

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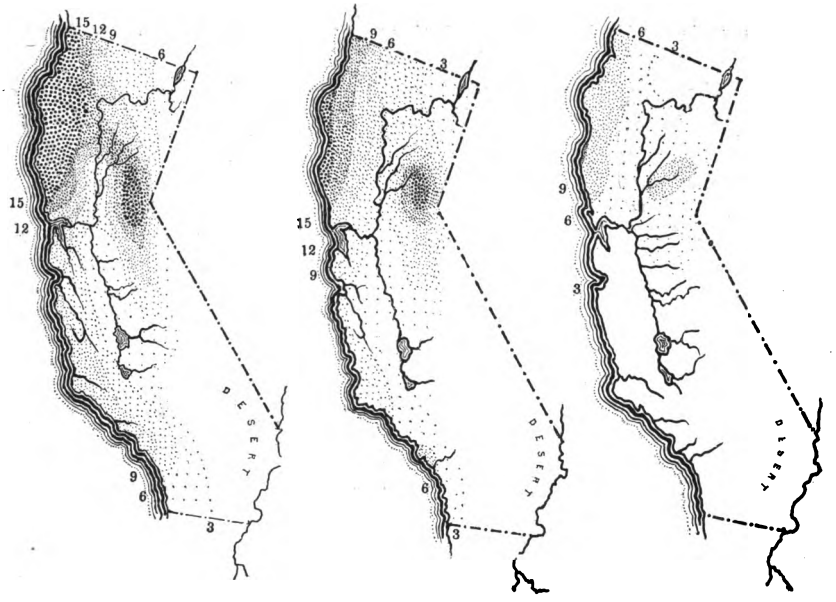
Practically speaking, San Francisco is the only port of export for wheat in California. Consequently, one of my main interests there was to ascertain the nature of the exported varieties, and the details of handling. To see the loading, to sample the shipments, to haunt the chamber of commerce, to study the commercial reports,—these were the errands.

"It is when I am hunting grain merchants that I get into trouble. I took a car precisely like those that used to run in North Sydney. A good many people wanted to ride on that car—or any other car that came along. I rode on the back platform. The conductor urged all and sundry to get inside.



I. October to December. II. January to March. III. April to June.

I. Map of the average rainfall of the State of California during the months of October, November, and December—that is, the autumn months. It will be seen that the San Joachin Valley receives from three to six inches of rain during these months. During the months from October to March, inclusive, the rainfall in the San Joachin Valley, in the most favoured portions, averages twelve inches.

II. Map of the average rainfall in the State of California during the months of January, February, and March—that is, the winter months. The portion left white and marked desert has less than three inches of rain. The San Joachin Valley receives from three to six inches of rain during these months.

III. Map of the average rainfall in the State of California during the months of April, May, and June. It will be seen that less than three inches of rain falls in the southern half of the State during these months. During the three following months, *i.e.*, the months of July, August, and September, the whole State averages less than three inches of rain.

'Get right inside!' said he. The confident manner in which he repeated this invitation to miles of people on foot showed unbounded faith in the capacity of the 'inside' of his car.

"I was amazed at the number that crowded in. There were sixteen others on the rear platform with me, the outsiders leaning out at an angle of forty degrees, more or less. These got off and took a rest every time the car stopped. Nobody grumbled except some who complained that the Car Company did not offer to carry United States Volunteers free of charge.

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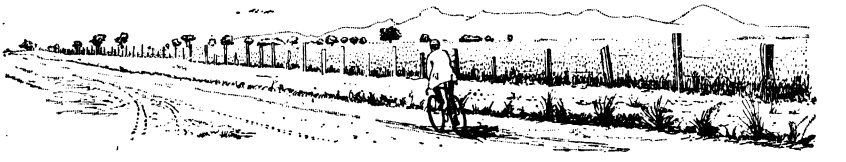
The cars run past the camp, and as there are 15,000 volunteers, these remarks showed a faith in the capacity of the cars that was even greater than the conductor's.

"I asked the conductor how many he could carry. 'Well, I guess about a hundred and thirty or a hundred and forty,' said he; 'sometimes a hundred and fifty,—it depends on how they pack up inside. If they don't block the doors we can manage a hundred and fifty.' This mass of humanity, hanging together like a swarm of bees, was whisked along at fifteen miles an hour If anything should go wrong—it wasn't pleasant to think of! We took chances, but we 'got there' quick. It is the way of the country. When our passengers alighted I counted ninety, and there were fully forty going farther up the line. When I unpacked myself, I found I was flat on the side next the platform rail and hexagonal the rest of the way round. Still I didn't grumble; I even caught myself congratulating the Company on having taken in seven dollars in one trip of twenty minutes."

At the present time most of the wheat of California is taken away in sailing vessels, but there is good evidence that the sailing vessels have seen their best days in this trade. Already steamers are chartered to carry grain, even to Europe, moreover, by way of the Suez Canal, and their number increases from year to year. With the production of better and cheaper fuel in the shape of both coal and oil it is certain that steam will become a more prominent factor in the Californian marine. Cheaper and better coal has



"I made some short side trips in the vicinity of the Yuba Mountains."

lately been found on the Pacific Coast, and oil is expected, at no distant date, to fall as low as two to three shillings a barrel. With the advent of steam, bulk handling and elevators seem to be assured.

All the varieties of wheat mentioned in the foregoing pages are exported, but Sonora, Club, and White Australian, in the order named, are the principal exports in the grain line. Probably not far from half of the total of the grain exported is Sonora.

The quality of Californian grain, as exported, is fairly well known in this State, more or less of it having reached these shores for some years past. As a rule it is rather small in the grain, but fairly clean and of good weight. The flour made from it is of ordinary quality—certainly not of the highest quality.

No method of handling grain not already mentioned in these pages was seen at San Francisco except a better method of sliding bags to vessels by gravity; this method is described in my recent article on "Grain Elevators." These observations terminated my visit to the Californian metropolis.

And so it happened that at the end of a hot July afternoon I seized my "grip," boarded the Powell-street car, and rumbled off down to the Ferry, *via* Market-street, bound for the North. Soon we were out on the bay, and San Francisco, her hills, towers, chimneys, and masts, gradually became lost in the rolling mists—a sad symbol of the inevitable dimming and disappearing in the mists of time of my own vivid recollections of her.

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V.

NORTHERN CALIFORNIA, OREGON, AND WASHINGTON.

"Shasta rose up and pursued us."

NORTHWARD from Oroville, my observations for several hundred miles were confined to what could be seen from the railway carriage. This was along the upper reaches of the Sacramento River, where the railway threads narrow valleys among great mountains, where the farmers grow barley hay, and where timothy and red-top and alfalfa and clover thrive. Even here I saw some few small areas of Club wheat.

View of "Oregon Club" wheat. The ear is shown full size, being cut in two in the middle, and having the upper half turned, so as to give both profiles in one view. The grains are shown in different ways; the lower is a back view; the middle, a side view; while the top one is shown in cross-section.

To be sure I made some short side trips in the vicinity of the Yuba Mountains. Near Woodlands and Marysville I saw what appeared to me about the best wheat and orchard country in the whole State, excepting, perhaps, for fruit, the San José region.

Here the prevailing varieties were White Australian and Club, and they were usually harvested with the aid of the combined harvester, though the reaper and binder was occasionally seen. Straw is apparently of more value here than in some other parts of the State. The towns of this region have a more "long established" look than elsewhere in California, and the people are accused by the inhabitants of other parts of the State of being slow, an accusation which these people bear with equanimity. When we are so prosperous that we do not need to hustle, we take things easier and so give envious neighbours a chance to say things.

View of Little Club wheat, or as it is called in California, simply "Club," or sometimes "Golden Gate Club." The ear is shown half-size, being cut in two in the middle, so as to allow both profiles to be shown in the one illustration, an end accomplished by turning the upper half through 90 degrees. The grains are shown full size, and their unsymmetrical character somewhat indicated. The lower grain is seen from the back, the middle from the side, while the top grain is shown in cross-section.

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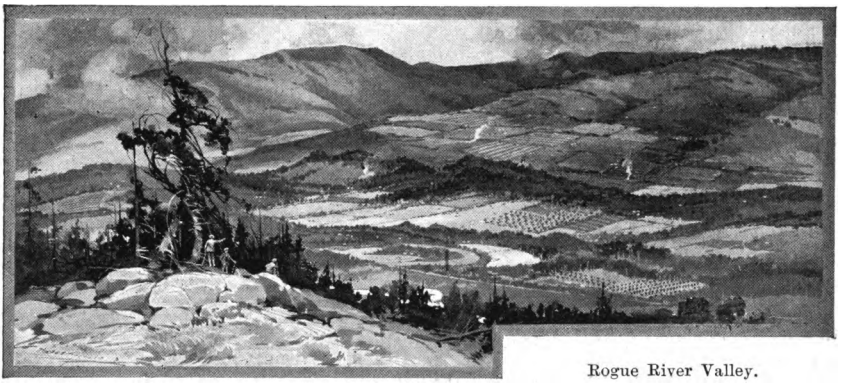
We approached Mount Shasta. We quenched our thirst at Shasta Springs, where a small river of mild carbonaceous water has its origin. We changed engines at the foot of Shasta, and started to leave that enormous mountain



Rogue River Valley.

"Valleys among great mountains, where the farmers grow barley hay, and where timothy and red-top and clover and alfalfa thrive."

behind, but this was not so easy! Shasta rose up and pursued us for the remainder of the day,—it was like the moon in the sky. Under cover of darkness we escaped. Fifteen thousand feet of snow-crowned rock, the half-way milestone in a memorable journey.

Following the Willamette River we enter Portland, Oregon, and go on to Washington. In these states we encounter a wheat industry of a somewhat different sort. Here we find a more modern conception of agricultural commerce and, in harmony with this conception, a much more rapid growth of the wheat industry. These two states, although opened up within twenty years, have far outstripped California in the production and export of wheat, in spite of the fact that the latter State had nearly a century the start, and that its growers receive better prices on the farm by five to fifteen cents per

"Following the Willamette River."

bushel. If we seek the reason for this we do not, it seems to me, find it in a difference in physical conditions more than in the keen perception at the north of what is best in the way of handling and trade.

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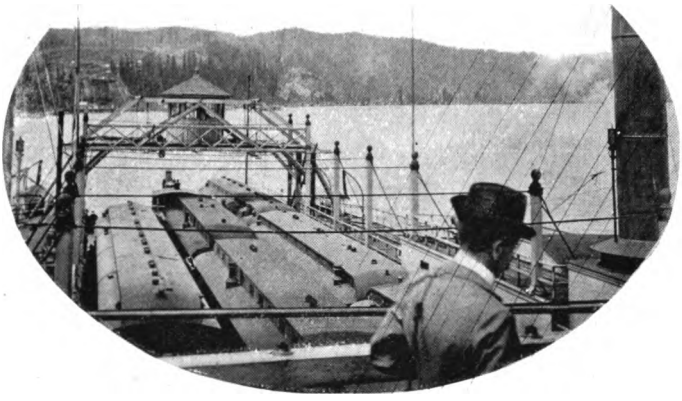
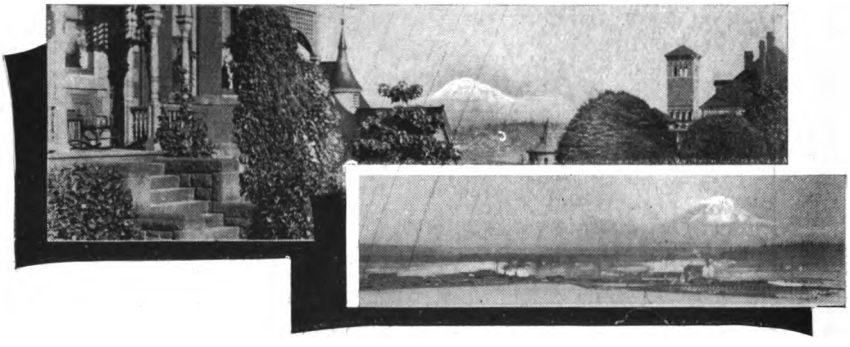
At the beautiful city of Tacoma, Washington, I received a striking confirmation of my observations on the wheat grown in that State. As before stated, the variety seen by me was on nearly all occasions the "Club" wheat,



Train being ferried across the Columbia River, Oregon.

"Little Club," as we call it in Australia. Information gained from inquiry was to the same effect, but less decisive. At Tacoma I found a double track leading to the elevator, and along this track I found wheat growing. It had been derived from the leakage of the trucks during the previous season, and, look as I might, I could find nothing but Little Club. This evidence was "unanimous," and it seemed to me very trustworthy. I had no longer any doubt that this variety is the strongly prevailing variety.



"At the beautiful city of Tacoma."

The varieties of wheat grown are much the same at the north, but with a smaller proportion of Sonora. The combined harvester, however, does not hold such undisputed sway, the moist weather compelling the use of the reaper

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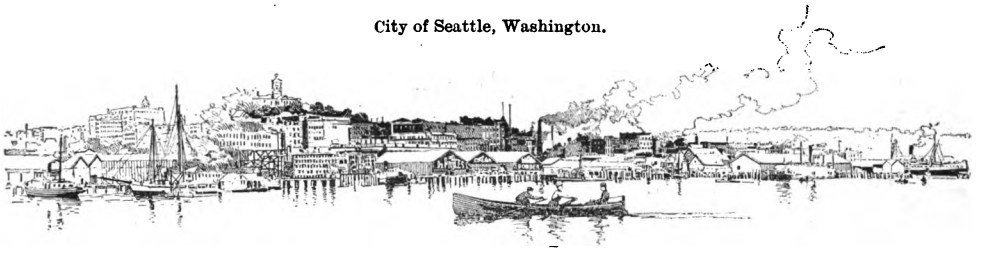
and binder in some parts, more particularly in the mountain valleys. When all is said on this subject, however, these mountain valleys do not by any means produce the bulk of the wheat of these two states, and on the dry plains the header and the combined harvester are the prevailing machines. A most important difference is in the growing use of bulk carriage and storage, under the guidance of the men of Minnesota and the north-west generally. Much of the wheat of these states is now handled in this manner, and the thoughtful visitor will not fail to see in these agencies one of the important factors in the rapid growth of their wheat industry, especially as the growth, even inside these states, has been most rapid precisely where the bulk system and elevators prevail.

Wheat has been grown in California for a century; flour mills have been in existence there for some eighty years.

The State of Washington, only a dozen years old, wilderness less than twenty years ago, to-day produces nearly as much wheat as California, and exports more.

This is a matter that seems to me to be worthy the careful attention of those among us who are responsible for the growth and prosperity of the

City of Seattle, Washington.



"Will my ship ever again float into your port, fair queen of the quiet waters?"

Australian wheat industry. Here is a state that has sprung up within the memory of our school children, and yet is exporting more wheat of our own class than the whole of Australia, and sending much of it to the same market over a road thousands of miles longer. They are people of our own race and social conditions, approximately speaking. Statistics show that, although their land is more productive than ours in the proportion of nearly two to one, their labour is much better paid, and that the price of wheat at the farm is lower. It should be added that product per acre is not a measure of fertility; there is no evidence that our wheat areas are so much less fertile as the yields would indicate. If the use of the drill were universal here, as it is on the Pacific Coast of the U.S.A., our yields would certainly be higher than they are at present. The value per acre of the wheat produced on the two areas is about as 9 to 7 in favour of Washington and Oregon. The value per acre is the same in California and New South Wales.

It was from Seattle that I left the Pacific Coast, bound for the great wheat fields of Dakota, Minnesota, and Manitoba. The past and the possible future of this marvellous little city of Seattle had filled me with wonder.

"On the train I fell into a reverie. I saw a little girl come to the shores of the Pacific to play—full of life and boundless activity. She made small fleets and sailed them, and she toyed with trains of cars; she made paths and houses, and all the time she grew and became more

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charming, and fuller of maidenly vigour. Her attractions brought her admirers, even from beyond the seas, and at last Uncle Sam's sailor boys asked to be permanently stationed within her sphere. Triumph after triumph was hers; her fame spread far and wide. Her natural beauty and her original ways, a little loud maybe, but full of the grace of youth and generous feeling, won all who saw her, so that while yet a maiden her circle of adherents grew so marvellously as to attract the attention of distant and grave statistical savants. It was at this time that fortune threw me into her society, and she graciously gave me, as her guest, more than a passing glance of those keen, laughing eyes. I was charmed, and I passed on with a regret only partially assuaged by her hand-waved adieu. Was I mistaken, or did those fingers go suspiciously near her lips? It was curiously like coquetry for a maid grown up among the fir trees."

"Will my ship ever again float into your port, fair queen of the quiet waters? And will those eyes sparkle as kindly as of yore? That future day will see you possessed of mansions and domains, and all that boundless wealth can buy. I wonder if your freshness will be proof against these, and if I shall like you as well? Who can tell? You will be different, and,—it will be a different I.

"Lake Pond de Ray!" shouted the breezy guard, as he bustled through the car; "Wake up for Lake Pond de Ray!" My day-dream was ended.

"I had never heard of this lake (Lake Pend d'Oreille), and yet it took hours for our train to skirt its shore. This was in Idaho, and I felt that I was well on my way to the great wheat fields of Dakota and Manitoba."

"Lake Pond de Ray!" shouted the breezy guard
"Wake up for Lake Pond de Ray!"

Sydney: William Applegate Gullick, Government Printer.—1901.

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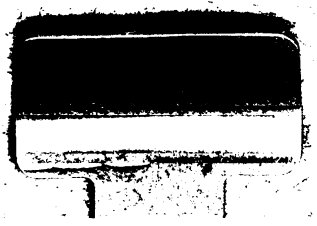

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